A Unified Extension of Special Relativity for Objects with Mass and Photons

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Abstract

This paper proposes an extension of the theory of special relativity, starting from the need to eliminate certain paradoxical situations arising from unclear interpretations of the equations, culminating in the integration of photons as a reference point for measurements of other types of particles.

To resolve these physically unfounded and merely assumed situations, the paper introduces an interaction factor, denoted as $f(m)$ - the Iurascu factor. This factor modifies the Lorentz transformation equations, leading to a new formula for the Lorentz factor, denoted as γ':

$$\gamma' = \frac{1}{\sqrt{1 - \frac{v^2}{c^2} \cdot f(m)}}$$

where:

$$f(m) = \begin{cases} 1, & \text{for objects with mass } (m > 0) \\ 0, & \text{for photons } (m = 0) \end{cases}$$

Photons were excluded from these equations not because the equations couldn't be adapted to them, but because they failed to account for the duality of particle types. Einstein saw only one aspect of light, its speed. And the world settled for the speed of light, ignoring the other fundamental components of the photon: time and space.

This approach allows for the unification of transformation equations for both types of particles - with and without mass — eliminating paradoxes. Thus, special relativity is extended to a more complete, coherent, mathematically robust, and physically justified form.

1. Introduction

Ultimately, the universe is composed of various forms of energy. Some of it exists as particles without rest mass, and some as energy condensed into bodies with mass. This physical distinction is also reflected mathematically in the equations of special relativity.

The original equations of relativity were designed strictly for objects possessing mass. For this reason, they did not apply to photons, which are massless. Attempting to insert photons into these equations without considering mass inevitably led to division by zero, generating well-known paradoxes and consequences in physics.

More concerning is that photons were attributed characteristics not physically proven, justified only by the claim that 'this results from applying the equations of special relativity'... although this is precisely the issue: photons couldn't be integrated into those equations for the reasons mentioned above.

To overcome this limitation, the factor $f(m)$ is introduced to mathematically complete the equations and provide a solid physical foundation for this change. Once the mass-related mathematical reference is corrected, the photon integrates perfectly into the relativity equations without generating inconsistencies or contradictions.

Moreover, the photon not only fits into the mathematical framework, but through the conclusions of the equations it becomes a reference point for measurements of all particles.

Physical Justification

From a physical standpoint, current observations and direct or indirect evidence show a universe dominated by fundamental energy fields that underlie both massless particles and the condensation of energy into massive bodies.

These fields and their corresponding particles are in constant motion and transformation within physical space, resulting in a succession of events manifesting under the conceptual umbrella of time. Thus, space is the physical medium where all forms of energy interact and occupy possible positions, while time is the uninterrupted transformation of these energy forms.

There is no absolute time outside the universe; time is this continuous transformation of its energy.

Under these conditions, photons remain in a stable state, unaffected by time and space dilation. The time and space of photons cannot be something opposite to light — they are integral to the stability of light's speed. The interpretation that proper time and proper space are zero simply means that there is no time or spatial difference between the photon and light. Therefore, their ratio must be 1 from the outset, even before writing any equation.

Clearly, when comparisons are made, they lead to zero... because there is no distinction between the wave motion and the photon! Photons essentially ensure motion —

there is no movement without energy! But if the difference is zero, it doesn't mean time is zero, and if the spatial difference is zero, it doesn't mean displacement didn't occur!

As the equation will show, the speed of light is based on two other constants: the photon's time and its dimensions. It is illogical for the speed of light to be a rational quantity while its defining components do not follow the same logic!

With regard to massive bodies, the physical situation involves more complex interactions, manifested through strong contacts that affect both dimensions and internal transformations, essentially a slowing down of everything related to time. As a result, these physical transformations have mathematical counterparts — precisely where the equations of special relativity were already in development. This is why the mass factor m reflects this complexity and identity, having a value of 1.

Time dilation and length contraction are based precisely on this stability of energy at the fundamental level! Massless energy is stable and constant, while energy condensed into more complex forms-i.e., massive bodies — is subject to changes depending on mass and speed.

2. Context and Development

The analysis begins with the equations of special relativity. Einstein originally created them to observe differences between particles, especially those with mass. When comparing different bodies, differences in time and space become evident. But if you compare two bodies with identical characteristics, naturally you'll get equality.

The issue is that Einstein stops there. Normally, we should ask whether massless particles are stable or also subject to spatial dilation and length contraction.

If we try to insert the photon's speed into the equations, we see that $v/c = 1$. Then, logically, a problem arises. When the equations were created, their purpose was to prevent objects with mass from reaching the speed of light.

The problem is that the equations didn't focus on objects with mass potentially reaching light speed, but rather on the speed of light itself, forbidding other particles from entering the equation at that speed!

And clearly, when applying the equation to the photon, that "1" under the square root prevents a valid result! The fact that you get zero means these equations, in their original form, don't apply to massless particles — and therefore none of the conclusions drawn for massive particles apply either!

That is, you cannot claim that the photon's time dilates to infinity and becomes zero, nor that its space contracts to zero! The photon does not travel instantaneously!

Now let's look at Minkowski's metric. Here we see that the proper time and space for the photon are zero.

The fact that we have space and time $(0, 0)$ represents the origin point on a "ruler"! The photon is the beginning, and from it all other comparisons and measurements are

made!

Getting zero simply means there's no difference between light and the photon! The difference is zero and the ratio is one!

Now look at Minkowski's light cone! Light/photons separate the world of massless particles from the world of massive ones. This reality and this diagram, among others, reinforce the reason why the interaction factor $f(m)$ must be either 1 or 0!

Photons exist in a specific environment: the electromagnetic field. These particles are massless in relation to those with mass. They exhibit the well-known wave-particle duality.

This blend both hides and reveals the fact that the photon has a reference frame within itself — within light, within the wave!

Photons are their own reference frame — and a reference frame for the rest of the universe. That doesn't mean they're the only one or something absolute. But we can't just choose their speed as the only constant! Furthermore, photons don't stand still; they interact within their own environment and in different environments. They are reference points that help establish other coordinates of time and space. They are just "zero" on the ruler — just the beginning. The speed of light cannot have its value if the photon's time and distance were truly zero in the reality of universal interactions. Wherever photons go, they carry their reference frame with them — they bear the label $(0, 0)$!

The fact that everyone else refers to light and its speed is absolutely correct. But the distance traveled by the photon is the same for both us and the photon! The photon essentially has two aspects: a self-reference space that is zero, and a real distance traveled, different from zero — just as it appears to us.

Likewise, its time is dual: it has a self-reference time that is zero, and a real time as part of the continuous transformation of universal energy — a time that is the other constant underlying its speed.

This means that if we transpose reality into equations, we return to the equations of special relativity. And even before creating or modifying equations, we observe that the observers' time must be the photon's time, and the observers' length/space must be referenced to the photon. That is, their ratio must be equal — that is, 1. We can write new equations or adjust existing ones to make everything complete. The factor $f(m)$ does exactly that: it either confirms that the equation is suitable for objects with mass that must not reach the speed of light — $f(m) = 1$ — or it lifts the restriction (within the equation) for massless particles to reach light speed — $f(m) = 0$.

And then, if the restriction is lifted, everything proceeds according to real-world physics, and it becomes clear that the photon is not subject to time dilation or length contraction. So, everything began a century ago from the failure to apply dialectics to all discussed aspects. Now, the photon is free, and the "parents" of speed — distance and time — have reunited to see the world for themselves. The photon offered light to the world, but traveled instantly without seeing anything.

3. Solution: Unified Lorentz Transformation Equation

To eliminate this problem, a function $f(m)$, dependent on mass, is introduced to modify the Lorentz factor. The new factor becomes:

$$\gamma' = \frac{1}{\sqrt{1 - \frac{v^2}{c^2} \cdot f(m)}}$$

The function $f(m)$ has two values:

- $f(m) = 1$ for objects with mass
- $f(m) = 0$ for photons

This modification is mathematically justified because it preserves the classical form of the equations. Physically, it reflects that time dilation and length contraction occur only for objects with mass.

4. Results and Modified Equations

4.1. For Objects with Mass ($m > 0$)

Apply $f(m) = 1$:

- Time:

$$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2} \cdot 1}}$$

- Length:

$$L = L_0 \cdot \sqrt{1 - \frac{v^2}{c^2} \cdot 1}$$

These equations confirm that relativity theory is valid for matter, and the proposed solution includes it as a limiting case.

4.2. For Photons ($m = 0$)

Apply $f(m) = 0$:

- Time:

$$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2} \cdot 0}}$$

$$t = \frac{t_0}{\sqrt{1}} = t_0$$

- Length:

$$L = L_0 \cdot \sqrt{1 - \frac{v^2}{c^2} \cdot 0}$$

$$L = L_0 \cdot \sqrt{1} = L_0$$

By correcting the mass-related mathematical reference, the photon gains a coherent description: it has time and physical dimensions, neither zero nor infinite, and the relativity equations remain perfectly valid and applicable.

So it wasn't us who gave the photon its formula — it gave it to us!

$$\text{Speed of light} = \frac{\text{Distance traveled by the photon}}{\text{Time taken by the photon}}$$

And from this, we can derive separate values for distance and time. This doesn't mean other methods of calculation or reference aren't valid...

5. Conclusion

Introducing the function $f(m)$ solves a fundamental mathematical problem within the theory of relativity, while also providing a clear physical distinction between objects with mass and massless objects.

Thus, the theory of relativity is completed and strengthened, with the speed of light now accompanied by two additional reference dimensions: the time and space (dimensions) of the photon. The photon is no longer just theoretical light — it is physically real, no longer emitted and absorbed as if by magic, but in accordance with the laws of nature, so that mathematics reflects physical reality. Einstein had only discovered the tip of the iceberg. Now the iceberg is coming to the surface and revealing everything. Massless particles should have been the beginning of the theory of relativity and particles with mass would have confirmed the dual situation.

It's time for reunification!

6. References

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